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Key indicators

Single-crystal X-ray study T = 295 K Mean σ (C–C) = 0.007 Å R factor = 0.072 wR factor = 0.160 Data-to-parameter ratio = 8.3

For details of how these key indicators were automatically derived from the article, see http://journals.iucr.org/e.

10,11-Dihydrocinchonan-9-ol

Arising from a hydrogen bond between the OH group of one molecule and the quinuclidine N atom of an adjacent molecule, molecules of the title compound, $C_{19}H_{24}N_2O$, [also known as (3R,8S,9R)-10,11-dihydrocinchonidine] are linked $[O \cdots N = 2.749 (4) \text{ Å}]$ into a helical chain that runs along the shortest axis of the orthorhombic unit cell. The compound is isostructural with cinchonidine (which has a vinyl group instead of the ethyl group), whose structure has been described in detail [Oleksyn (1982). Acta Cryst. B**38**, 1832–1834].

Comment

The principal alkaloids of the Cinchona tree comprise eight compounds: the (+)-isomers cinchonine, quinidine and their dihydro derivatives, as well as the (-)-isomers cinchonidine, quinine and their dihydro derivatives. The structure determination of 10,11-dihydrocinchonidine (Fig. 1) now completes the quartet of structures of this important class of antimalarial drugs; the crystal structures of the other three, *viz.* (+)-cinchonine (Oleksyn *et al.*, 1979), (-)cinchonidine (Oleksyn, 1982) and 10,11-dihydrocinchonine (Kowalik *et al.*, 1999), have been known for some years.



Dihydrocinchonine differs from dihydrocinchonidine (as does cinchonine from cinchonidine) in the configuration of the atoms (numbered C7 and C8, respectively, in this structural study), dihydrocinchonine having a $3R_{,8}R_{,9}$ S configuration and dihydrocinchonidine a $3R_{,8}S_{,9}$ R configuration. Dihydrocinchonine exists as a molecule with an intramolecular $O \cdots N$ hydrogen bond [2.688 (3) Å] (Kowalik *et al.*, 1999); there are no other signficant interactions in the crystal structure. On the other hand, cinchonidine features an intermolecular hydrogen bond [2.76 (5) Å] (Oleksyn, 1982) that links adjacent molecules into a chain. The addition of two H atoms across the vinyl double bond of this compound leads to no significant changes in packing in the resulting title molecule, and as the two compounds crystallize with matching cell dimensions, they

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1533 reflections with $I > 2\sigma(I)$

-3

 $R_{\rm int}=0.050$ $\theta_{\rm max} = 25.0^\circ$ $h = -11 \rightarrow 12$ $k = -17 \rightarrow 24$

 $l = -8 \rightarrow 8$



Figure 1

ORTEPII (Johnson, 1976) plot of (I). Displacement ellipsoids are drawn at the 50% probability level and H atoms are shown as spheres of arbitrary radii.

are isostructural. The structure of cinchonidine has been described in detail; a similar description applies here.

Experimental

Cinchonidine (60.0 mg, 0.202 mmol), tetrahydrofuran (30 ml) and an appropriate amount of the catalyst Pt-PVP- α -Al₂O₃ were placed in a stainless steel autoclave (60 ml) along with a stirring bar. The autoclave was evacuated and flushed five times with hydrogen (99.995%) before it was filled with hydrogen. The autoclave was heated and stirring commenced. The reaction was quenched by immersing the autoclave in cold water. The solid that was obtained from the hydrogenation reaction was washed with water, dried and purified with ethanol. Crystals (m.p. 542-545 K) were obtained by the slow evaporation (over two months) of a chloroform solution of the compound. Elemental analysis: C 76.64, H, 8.47, N 9.16%; calculated for C₁₉H₂₄N₂O: C 76.98, H 8.16, N 9.45%. ¹H NMR (300 MHz, $CDCl_3$, J in Hz): $\delta 0.79 (t, 3H, J = 7.5), 1.22 (m, 2H), 1.48-1.62 (m, 3H),$ 1.68-1.82 (m, 3H), 2.44 (m, 1H), 2.66 (m, 1H), 3.08 (m, 2H), 3.61 (m, 1H), 5.79 (d, 1H, J = 3.3), 7.69 (m, 1H), 7.76 (d, 1H, J 4.5), 7.81 (m, 1H,), 7.96 (d, 1H, J = 8.7), 8.06 (d, 1H, J = 8.7), 8.88 (d, 1H, J = 4.5).

Crystal data

$C_{19}H_{24}N_2O$	Mo $K\alpha$ radiation
$M_r = 296.40$	Cell parameters from 1148
Orthorhombic, $P2_12_12_1$	reflections
a = 10.518(1) Å	$\theta = 2.1 - 18.5^{\circ}$
b = 20.610 (2) Å	$\mu = 0.08 \text{ mm}^{-1}$
c = 7.4612 (8) Å	T = 295 (2) K
V = 1617.4 (3) Å ³	Rod, colorless
Z = 4	$0.39 \times 0.14 \times 0.13 \text{ mm}$
$D_x = 1.217 \text{ Mg m}^{-3}$	

Data collection

Bruker SMART APEX area-	
detector diffractometer	
ω and ω scans	
Absorption correction: none	
3440 measured reflections	
663 independent reflections	
-	

Refinement

5

Refinement on F^2 $w = 1/[\sigma^2(F_o^2) + (0.0633P)^2]$ $R[F^2 > 2\sigma(F^2)] = 0.072$ + 0.5083P] where $P = (F_o^2 + 2F_c^2)/3$ $wR(F^2) = 0.160$ S = 1.29 $(\Delta/\sigma)_{\rm max} = 0.001$ $\Delta \rho_{\rm max} = 0.21 \ {\rm e} \ {\rm \AA}$ 1663 reflections $\Delta \rho_{\rm min} = -0.15 \text{ e} \text{ \AA}^{-3}$ 200 parameters H-atom parameters constrained

Table 1				
Selected	geometric	parameters	(Å,	°).

1 412 (5)

O1-C8	1.413 (5)	C7-C8	1.542 (6)
N1-C1	1.469 (5)	C8-C13	1.520 (6)
N1-C5	1.474 (5)	C9-C10	1.521 (7)
N1-C7	1.483 (5)	C11-C12	1.407 (7)
N2-C11	1.311 (7)	C12-C13	1.361 (6)
N2-C19	1.356 (7)	C13-C14	1.428 (6)
C1-C2	1.552 (6)	C14-C15	1.407 (6)
C2-C9	1.517 (6)	C14-C19	1.427 (6)
C2-C3	1.539 (7)	C15-C16	1.348 (6)
C3-C6	1.525 (6)	C16-C17	1.400 (7)
C3-C4	1.533 (6)	C17-C18	1.360 (7)
C4-C5	1.529 (6)	C18-C19	1.411 (7)
C6-C7	1.544 (6)		
C1-N1-C5	107.8 (3)	O1-C8-C13	111.1 (4)
C1-N1-C7	107.4 (3)	C7-C8-C13	110.7 (3)
C5-N1-C7	111.4 (3)	C2-C9-C10	112.9 (5)
C11-N2-C19	116.1 (4)	N2-C11-C12	125.4 (5)
N1-C1-C2	112.0 (4)	C11-C12-C13	119.7 (5)
C1-C2-C3	106.6 (4)	C12-C13-C14	117.5 (4)
C1-C2-C9	113.1 (4)	C8-C13-C12	121.8 (4)
C3-C2-C9	115.1 (4)	C8-C13-C14	120.7 (4)
C2-C3-C4	107.6 (4)	C13-C14-C15	124.6 (4)
C2-C3-C6	110.9 (4)	C13-C14-C19	117.9 (4)
C4-C3-C6	108.2 (4)	C15-C14-C19	117.5 (4)
C5-C4-C3	107.2 (4)	C14-C15-C16	122.3 (5)
N1-C5-C4	112.4 (3)	C15-C16-C17	120.4 (5)
C3-C6-C7	109.1 (3)	C16-C17-C18	119.5 (5)
N1-C7-C6	110.4 (3)	C17-C18-C19	121.8 (5)
N1-C7-C8	112.1 (3)	N2-C19-C14	123.3 (5)
C6-C7-C8	114.2 (4)	N2-C19-C18	118.2 (4)
01-C8-C7	110.4 (3)	C14-C19-C18	118.5 (5)

The orthorhombic cell axes [10.518 (1), 20.610 (2) and 7.4612 (8) Å] were arranged in a non-standard setting to match those of cinchonidine [10.941 (3), 20.883 (4) and 7.130 (2) Å] (Oleksyn, 1982), in the absence of significant anomalous dispersion effects Friedel pairs were merged. H atoms were placed at calculated positions (aromatic C-H = 0.93 Å and $U_{iso}(H) = 1.2U_{eq}(C)$, methine C-H = 0.98 Å and $U_{iso}(H) = 1.2U_{eq}(C)$, methylene C-H = 0.97 Å and $U_{iso}(H) = 1.2U_{eq}C$, methyl C-H and $U_{iso}(H) = 1.5U_{eq}(C)$, and O-H = 0.85 Å and $U_{iso}(H) = 1.2U_{eq}(O)$, and were included in the refinement in the riding-model approximation. The hydroxyl group was rotated to fit the electron density.

Data collection: SMART (Bruker, 2002); cell refinement: SAINT (Bruker, 2002); data reduction: SAINT; method used to solve structure: atomic coordinates taken from isostructural cinchonidine (Oleksyn, 1982); program(s) used to refine structure: *SHELXL*97 (Sheldrick, 1997); molecular graphics: *ORTEP*II (Johnson, 1976); software used to prepare material for publication: *SHELXL*97.

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